In order to determine the constants, two sets of experiments were carried out. In the first set the cups were made rapidly to rotate by opening the movable lid of the box and passing an air current through the wind channel; then the lid was suddenly closed, thus making $v$ zero, and the motion of the cups was recorded from that instant until the cups came to rest. The general equation reduces to—

$$d\omega/dt = a + b\omega + d\omega^2.$$

The constants $a$, $b$, and $d$ were determined from the results of the experiments. In the second set of experiments, the cups being initially at rest and the lid closed, a *constant* current was passed along the channel. The lid was then opened, and the motion of the cups began to be recorded from that instant. The general equation

$$d\omega/dt = (a + cv + fv^2) + (b + ev)\omega + d\omega^2$$

could be written

$$d\omega/dt = a' + b'\omega + d\omega^2,$$

where $a'$, $b'$ are constants depending on the constant velocity, an equation similar to the preceding. In this way all the constants of the general equation could be deduced, and the final result is

$$(t+4.9)d\omega/dt = -1.76 - 0.667\omega + 0.50v - 0.098\omega^2 + 0.140\omega v + 0.84v^2.$$

The interesting case for meteorologists is that of the steady state when $d\omega/dt$ is zero, and the anemometer is rotating uniformly with angular velocity $\omega$ in a steady wind velocity of $v$. The relation between $\omega$ and $v$ is then found by equating the right-hand side of the equation to zero. For values of $v$ greater than 3 meters per second the solution reduces approximately to $v = 0.90 + \omega/3.74$, which gives a linear relation between the wind velocity and the rotation of the cups.—*R. Corless.*

## REPORT OF THE WORK CARRIED OUT BY THE STEAMSHIP "SCOTIA," 1913.[1]

By G. I. TAYLOR.

[Reprinted from Science Abstracts, Sec A, June 25, 1915, § 653.]

* * * D. J. Matthews [hydrographer to the expedition] obtained full observations dealing with the bathymetry, salinity, temperature, and ocean currents of the area, and noted the position of all the ice observed. The observations indicate the conditions at the boundary of the cold, relatively fresh and slow-moving Labrador current which flows southward and southeastward from Davis Strait into the Atlantic, and the warm, saline and more rapidly-flowing Gulf stream, which flows across the path of the Labrador current from west to east and compels the latter to dive below.

Taylor's report [of the meteorologist] is noteworthy for the fact that on 14 separate occasions he was able to raise a kite carrying self-recording meteorological instruments from the deck of the *Scotia*, and to deduce from the records obtained important results with regard to the rate of propagation of temperature changes from the surface to the upper air, showing that the distribution of temperature in height is due to the action of eddies and resembles the process of heat conductivity in its mode of operation. New results regarding fog at sea are also obtained. In four of the kite ascents there was no fog, and the temperature uniformly fell with height (positive temperature gradient). The other 10 cases were associated with negative temperature gradients, and in 9 of them fog was noted to be present. Fog production appears to depend upon the mixing by eddy conductivity of layers of different temperatures and humidities, rather than upon the cooling below the dew point of a homogeneous mass of air. With regard to the suggested detection of the presence of icebergs from their effect upon the temperature of the sea, the conclusion is reached that in the regions visited by the *Scotia* the results obtained do not bear out the suggestion.—*R. Corless.*

[1] Report to the Board of Trade, London, 1914, 141 p. 4°. Text.

## RADIUM CONTENT OF WATER FROM GULF OF MEXICO.[1]

By S. J. LLOYD.

[Reprinted from Science Abstracts, Sec. A, July 26, 1915, § 863.]

The growing recognition of radium as an important factor in geological processes has led to a multiplication of analyses of rocks and soils for that substance. With the object of obtaining further evidence on the question of the distribution of radium in the ocean, which at a minimum estimate contains 1,000 tons of radium, the author has made a careful examination of the water of the Gulf of Mexico. The measurements were made in the usual type of vacuum emanation electroscope and the results, with those of other observers, are included in the following table:

| Observer. | Sea. | Radium per liter of water. |
|---|---|---|
| | | *Grams.* |
| Joly | Various oceans | $17.0\times10^{-12}$ |
| Eve (1907) | North Atlantic | $0.3\times10^{-12}$ |
| Do | do | $0.9\times10^{-12}$ |
| Satterly | English sea waters | $1.0\times10^{-12}$ |
| Lloyd | Gulf of Mexico | $1.7\times10^{-12}$ |

Excluding Joly's abnormally high results, an average value for the radium content of 1 liter of sea water is $1.2\times10^{-12}$ gm., representing a total amount of 1,400 tons in the sea. According to the author, 100 liters of sea water should contain from 0.3 to 0.5 milligram of uranium.—*A. B. Wood.*

[1] Amer. jour. sci., May, 1915, (4) 39:580-582.

## DISCUSSION ON ANTARCTIC METEOROLOGY.[2]

This discussion was opened by G. C. Simpson, briefly summarizing the general circulation of the atmosphere in the Southern Hemisphere as given in the textbooks, in Lockyer's "Southern Hemisphere surface air circulation," and Meinardus's "Discussion of the results of the *Gauss* Antarctic expedition."

1. Dr. Lockyer suggests an intense anticyclone over Antarctica, from which cold air feeds into a series of large cyclones circulating the southern ocean and having their centers near latitude 60°S. The cyclones are supposed to be so large that while their southern extremities sweep over the edge of Antarctica their northern extremities reach to latitude 40°S., and so dominate the weather of Tasmania and New Zealand and to some extent that of South Australia.

[2] *Reprinted from* Report of the Eighty-fourth Meeting of the British Association for the Advancement of Science, Australia, 1914. London, 1915. p. 302.

Prof. Meinardus's scheme[2] also includes a series of cyclones traveling from west to east over the southern ocean; but he gives strong reasons against the presence of an anticyclone over Antarctica. His chief objection to such an anticyclone is that anticyclonic conditions are accompanied by an excess of evaporation over precipitation: hence it would be impossible to account for the excess of precipitation which gives rise to the large glaciers and snowfields discharging the known large quantities of ice.

2. The simultaneous observations made at Cape Evans, Cape Adare, and Framheim were then considered to investigate the processes which are at work in the Ross Sea area. The chief conclusions were: The high southeasterly winds—commonly called blizzards [in the literature of Antarctica]—are not caused by cyclones passing into Ross Sea, but are the result of the large differences of temperature which exist in the lower atmosphere over the Barrier and Ross Sea. The cloud observations show that

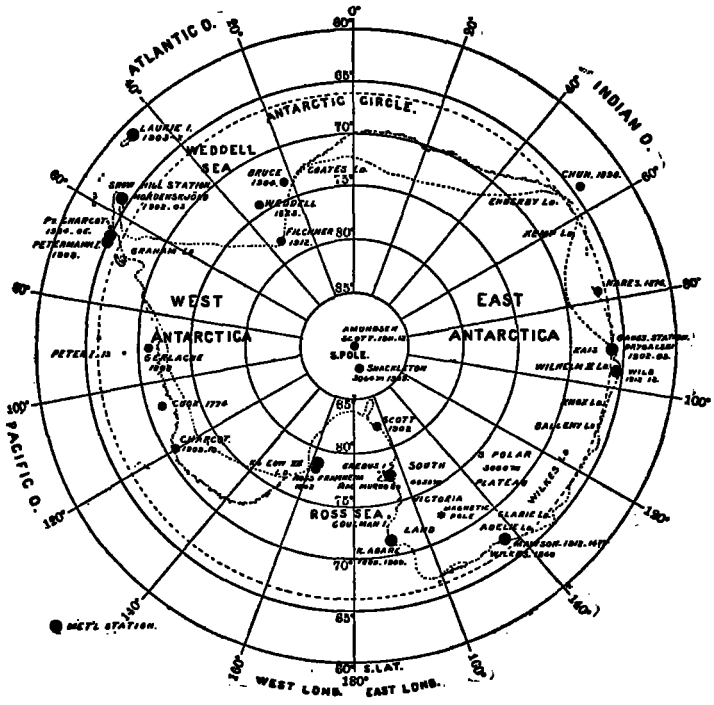


FIG. 1.—Location of meteorological stations within the South Polar Regions.

air feeds into the Antarctic at high levels and passes north again in the "blizzards." Meinardus's objection that in such a circulation precipitation would not exceed evaporation was shown not to hold, because of the great cooling of the air due to radiation. The air while sinking loses so much heat by radiation that, when forcibly made to rise again in the "blizzards," saturation is reached at a much lower level than that at which the air entered. Thus anticyclonic conditions are consistent with an excess of precipitation.

3. The existence of a belt of cyclones between Antarctica and Australia was then considered. Curves showing barometer and wind observations at the *Gauss* winter quarters were shown. From them it was seen that during the passage of deep waves of pressure there is practically no variation of the wind direction at that station. In most cases the wind blows a gale from the east both while the barometer falls rapidly and while it makes an equally rapid recovery. At present it appears quite impossible to reconcile the wind and barometer observations with any system of circulation of wind about a center of low pressure moving from the west to the east. Further, the simultaneous barometer observations at Melbourne, The Bluff, New Zealand, and at Cape Adare were examined without finding any certain indication of the same cyclone affecting the northern and the southern stations.

4. The monthly departures from the pressure normals at Cape Evans were compared with corresponding values for stations in Australasia, and an important negative correlation was found.

5. The importance of a permanent meteorological station on Antarctica was urged.

[2] See this REVIEW, April, 1914, 42:223-230.—C. A., jr.

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## LOW TEMPERATURE OF THE SOUTHERN HEMISPHERE.[1]

While discussing at the Australian meeting of the British Association for the Advancement of Science certain other physical features of Antarctica, Dr. G. C. Simpson made the following comments on the cause of the relative difference in temperature between the Northern and Southern Hemispheres:

"I think we do not sufficiently realize that the Southern Hemisphere is much colder than the Northern Hemisphere, and the reason for this difference is certainly not understood by scientists. When we think of the temperature of a place we think of the temperature in the lower atmosphere. Now, the mere passage of light through the atmosphere will not warm it. The main method by which the atmosphere becomes warmed up is by the sun shining on something it can warm. Now, in the Northern Hemisphere there are large masses of land which can absorb the sun's energy, and then give the heat to the atmosphere. In the Southern Hemisphere, on the contrary, the whole mass of land within the Antarctic Continent [Antarctica] is covered with ice, which is practically a perfect reflector, and therefore when the sun shines on it a large proportion of the energy is reflected into space. I think scientists have not quite realized how important that is—that 5,000,000 square miles of the earth's surface in the Southern Hemisphere reflect into space a large part of the energy received from the sun. I feel certain that this is one of the chief reasons for the difference in temperature between the Northern and Southern Hemispheres."

## AUSTRALIAN RAINFALL.[2]

By H. A. HUNT, Commonwealth Meteorologist.

The main factors to be considered in relation to the controlling causes of rainfall in Australia are the southeast and westerly trade winds, the monsoonal and southern depressions, cyclones from the northeast and northwest Tropics, locally formed cyclones, and the anticyclones, in conjunction with the modifying effects on these various atmospheric movements of the physical features of the different parts of the country.

Around the central dry area of Australia the isohyets describe somewhat concentric curves, the modifications being mostly due to variations in elevation. Thus the Darling Ranges to a great degree account for the rainfall of the southwest corner of the continent. The Flinders

[1] *Reprinted from* Report of the Eighty-fourth Meeting of the British Association for the Advancement of Science. London, 1915, p. 417.

[2] *Reprinted from* Report of the Eighty-fourth Meeting of the British Association for the Advancement of Science, Australia, 1914. London, 1915, p. 439-442.